Lighting Efficiency Case Study

5 Buildings at
Dublin City University
Glasnevin, Dublin 9

Works Carried out October – December 2009

Project Partially Funded by Sustainable Energy Ireland (SEI) – SEEEP
(Support for Exemplar Energy Efficiency Projects) Grant
Lighting Efficiency Project at
Dublin City University

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Overview:

Ciall Energy Saving surveyed, designed & installed energy saving technologies in 5 buildings throughout the DCU Campus in Glasnevin.

The project was in an effort to reduce DCU's Carbon Footprint as per the goal of the e3 Project. The e3 project is a joint effort between the 4 Dublin Universities – DCU, UCD, Trinity College & DIT - "To reduce carbon emissions in our buildings by 10% by 2010." For more information on e3 please visit the e3 website.

The buildings involved in this particular DCU project were The LIRC (Library & Information Resource Centre), Computer Applications Building, The Multi-Storey Car Park, Henry Grattan Building and the Old Larkfield Residences Block.

We utilised a vast number of technologies in each building ranging from Power Conditioning to T5 Adaption to Automation & Control processors. Ciall Secured a SEEEP grant from Sustainable Energy Ireland (SEI) for this project, which covered 60% of the overall cost for the University.

The savings from this project amounted to a reduction of 375,411kWh of electricity or over 200 tonnes of Co2 per year (with an ROI of less 17months excluding grant contribution).

The solution for each building was different- a mixture of Occupancy Sensors, New Fittings, alterations to existing fittings, power conditioning & automation were used to achieve the savings.

The following pages detail the works carried out in each of the 5 buildings and the savings achieved.
Multi-Storey Car Park

Prior to these works being carried out, the multi-storey car park lighting (5 levels + external lighting + lobby & stairwell lighting) was controlled from a lighting switch panel located in the basement of the car park. The lights had to be manually controlled and security staff were expected to adjust the lighting levels according to usage of the car park and time of day. What ultimately happened was that the lights were left on almost all of the time, resulting in a massive waste of electricity.

The Lighting fixtures were made up of a mixture of high frequency & low frequency fluorescent lighting, Metal Halide and Sodium outdoor lighting and some signage lighting.

After investigating the problem Ciall came up with a unique solution - a mixture of Automation & Power Conditioning.

**Lighting Automation:**

The idea was to get rid of the old lighting panel and replace it with a lighting automation panel which would automatically adjust the lighting at various intervals during the day, based on different factors – time of day (astronomical clock), lighting levels (Lux Sensors), usage of the car park and whether the college was ‘in term’ or on ‘holidays’.

The solution allowed for manually controlling the lighting on all levels if required, and the ability to set each car park level to 30%, 60% or 100% brightness. This portion of the project resulted in massive savings, by simply reducing the amount of time each lamp was switched on.

The system was connected to the college LAN so the lighting can be controlled from any PC on the network and can be integrated with BMS.
The Following is a screen shot from the lighting interface:

The diagram represents a cross section of the car park. It is possible to change the lighting setting on each level simply by clicking on that section. Or each section can be left in “Auto” mode.

An Over-ride switch was also built into the system to switch all lights to 100% in the event of an emergency or for maintenance.

**Power Conditioning:**

In addition to the automation, a total of 11 Power Conditioning Units were installed in the various distribution boards throughout the car park. The Power Conditioning units were installed to supply all of the 5’ low frequency fluorescent fittings in the car park.

The effect of these units was to reduce the energy consumed by connected fittings by 30% after a warm up period.

For more information on power conditioning please see the power conditioning section of our website.
**Savings Summary:**

The Combination of Automation & Power Conditioning resulted in a saving of 214,622.02 kW/hrs per year.

Using our example Electricity Unit rates, this will result in an annual saving of over €28,000 + VAT. These massive savings and cost effective design resulted in a **return on investment period of less than 8 months (excluding grant contribution)**.

| Current Setup (assume 65% of building Load) | 572,422.75 | €48,620.41 |
| Proposed Setup | 157,780.70 | €29,568.64 |
| **Total Saved** | **214,622.02** | **€28,020.77** |

The Savings above do NOT take into account savings due to extended Lamp Hours or reduced maintenance costs. Therefore, there will be savings in excess of the figures listed above.

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### Accumulated Savings

<table>
<thead>
<tr>
<th>Years</th>
<th>Savings (£)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>6,000.00</td>
</tr>
<tr>
<td>2</td>
<td>12,000.00</td>
</tr>
<tr>
<td>3</td>
<td>18,000.00</td>
</tr>
<tr>
<td>4</td>
<td>24,000.00</td>
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<td>5</td>
<td>30,000.00</td>
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### Accumulated Carbon Savings

<table>
<thead>
<tr>
<th>Years</th>
<th>Carbon Savings (£)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>115.47</td>
</tr>
<tr>
<td>2</td>
<td>230.93</td>
</tr>
<tr>
<td>3</td>
<td>346.49</td>
</tr>
<tr>
<td>4</td>
<td>461.97</td>
</tr>
<tr>
<td>5</td>
<td>577.39</td>
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</table>

Please note that all DCU’s KW/hr supply rates are confidential, we have applied an example electricity unit rate of approx Day - €0.15 and Night - €0.09 to all of this report. This is a typical average day/night rate for a similar sized campus in 2009 in Dublin.
Computer Applications Building

The computer applications building is a mixture of undergraduate and post graduate computer labs and office areas. The main problem in this building was that lighting was being left on unnecessarily in labs and corridors.

Ciall’s solution was a mixture of PIR & Microwave Occupancy Sensors (with built in lux level meters) and power conditioning.

**Occupancy / Presence Detection**

Occupancy sensors were installed in all the main corridors and large computer labs. Microwave sensors were used to cover the long corridors. Ciall re-zoned the lighting circuits in each room to make more use of the lux sensors. This meant that light fittings near windows could remain off when the sun was shining, while fittings towards the centre or far end of the labs could still remain on.

Ciall also built in manual override switches to allow lecturers to manually control the light fittings while using over head projectors in the labs.

**Power Conditioning**

Power conditioning was utilised in some of the post grad areas. These were open plan / cubicle type office environments where occupancy sensors would not have been suitable. A total of 5 power conditioning units were installed on the 2nd floor of this building.

The effect of these units was to reduce the energy consumed by connected fittings by 30% after a warm up period.
For more information on power conditioning please see the power conditioning section of our website.

**Savings Summary**

The Combination of Occupancy Sensors & Power Conditioning resulted in a saving of 49267kW/hrs per year.

Using our example Electricity Unit rates, this will result in an annual saving of over €7,200 + VAT.

<table>
<thead>
<tr>
<th></th>
<th>No. of fittings</th>
<th>Total no. of lamps</th>
<th>Total wattage kW</th>
<th>kW/hr cost (6’/day)</th>
<th>kW/hr cost (6’yrs)</th>
<th>Annual KW/yr</th>
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</thead>
<tbody>
<tr>
<td>Existing Setup</td>
<td>36</td>
<td>1,924</td>
<td>42,796</td>
<td>€442.09</td>
<td>€5,264.17</td>
<td>10,528.35</td>
</tr>
<tr>
<td>Proposed Setup</td>
<td>36</td>
<td>1,324</td>
<td>40,052</td>
<td>€360.36</td>
<td>€4,567.52</td>
<td>9,135.05</td>
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<tr>
<td><strong>Total Saved</strong></td>
<td><strong>0</strong></td>
<td><strong>0</strong></td>
<td>2,728.62</td>
<td><strong>€141.62</strong></td>
<td><strong>€7,223.55</strong></td>
<td><strong>49,267.04</strong></td>
</tr>
</tbody>
</table>

The Savings above do NOT take into account savings due to extended Lamp Hours or reduced maintenance costs. Therefore there will be savings in excess of the figures listed above.

**Accumulated Savings**

<table>
<thead>
<tr>
<th>Year</th>
<th>Savings (€)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year 1</td>
<td>-€6,590.65</td>
</tr>
<tr>
<td>Year 2</td>
<td>€652.06</td>
</tr>
<tr>
<td>Year 3</td>
<td>€7,975.44</td>
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<tr>
<td>Year 4</td>
<td>€15,087.59</td>
</tr>
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<td>Year 5</td>
<td>€22,520.04</td>
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</table>

**Accumulated Carbon Savings**

<table>
<thead>
<tr>
<th>Year</th>
<th>Carbon Savings (tCO₂)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year 1</td>
<td>26.511</td>
</tr>
<tr>
<td>Year 2</td>
<td>53.91</td>
</tr>
<tr>
<td>Year 3</td>
<td>76.52</td>
</tr>
<tr>
<td>Year 4</td>
<td>106.02</td>
</tr>
<tr>
<td>Year 5</td>
<td>152.53</td>
</tr>
</tbody>
</table>

All values quoted are based on the average primary fuel mix used for electricity generation in the Republic of Ireland in 2006. (MAGPIE 2007: Source ESB).

Please note that all DCU’s KW/ hr supply rates are confidential, we have applied an example electricity unit rate of approx. Day - €0.15 and Night - €0.09 to all of this report. This is a typical average day/night rate for a similar sized campus in 2009 in Dublin.
LIRC – Library & Information Resource Centre

The LIRC building in DCU is primarily made up of open plan library floor and study desks. There are also 17 collaborative study rooms / meeting rooms throughout the library and a number of other offices. There is a restaurant in the basement of the library also.

The library is open from 8am in the morning until 10pm most evenings. In the open plan areas the lights must be on all of the time and even after closing to allow for cleaning & maintenance. The primary type of light fitting in the library was high frequency 5foot T8 fluorescent fittings with a 58Watts Lamp running at approx 62Watts each.

![Library Interior](image)

The collaborative study room lighting was modular 600x600 4 x 18W fluorescent lamps and was switched locally. However these rooms were often left switched on when not in use, and sometimes overnight.

Ciall utilised a mixture of T5 adaptors and occupancy sensors to save energy in the LIRC. Actually carrying out the works in this building was quite difficult due to the opening hours. Most of the works had to be carried out very early in the morning before the library opened.

**T5 Adaption**

Over 400 T5 lamps and ballasts were retro-fitted to the original T8 fittings. This resulted in a reduction from 62Watts per fitting to 37Watts per fitting. Care was taken to match lamp colours and to suit the requirements of the library staff.
**Occupancy Sensors**

Occupancy sensors were installed in each collaborative study room along with 4 other rooms throughout the library.

**Savings Summary**

The Combination of Occupancy Sensors & T5 Adaption resulted in a saving of 50077.248kW/hrs per year.

Using our example Electricity Unit rates, this will result in an annual saving of over €7,300 + VAT.
Larkfield Residences Block

The Larkfield residences block in DCU is the oldest of the residence blocks in DCU. The building comprises of 3 stories of apartments built around a central courtyard. Ciall was asked to address the energy consumption of the corridor lighting which is on 24hours a day due to the lack of natural light.

The lighting was comprised of old 5foot T8 type fluorescent fittings running at approximately 64Watts each. Adapting these fittings to new T5 type lamps and ballasts was the obvious choice.

T5 Adaption

Each fitting had to be individually adapted to accept new T5 lamps, a time consuming task. This resulted in reducing the consumption of each fitting from 64Watts to 37Watts each.

The result of this not only increased efficiency but also the quality and colour of the light in the corridors.
Savings Summary

The installation of T5 Adaptors resulted in a saving of 23170.2kW/hrs per year.

Using our example Electricity Unit rates, this will result in an annual saving of almost €3,000 + VAT. This resulted in a return on investment period of just under 14 months (excluding grant contribution).

<table>
<thead>
<tr>
<th>No. of fittings</th>
<th>Total no. lamps</th>
<th>Total wattage kW</th>
<th>Whr cost (€/day)</th>
<th>kW/hr cost (€/year)</th>
<th>Annual kW/hr s</th>
</tr>
</thead>
<tbody>
<tr>
<td>Existing Setup</td>
<td>120</td>
<td>127</td>
<td>7.005</td>
<td>€21.18</td>
<td>€772.14</td>
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<td>Proposed Setup</td>
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<tr>
<td>Total Saved</td>
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<td>0</td>
<td>2.645</td>
<td>€6.00</td>
<td>€2913.87</td>
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</tbody>
</table>

The savings above do NOT take into account savings due to extended lamp hours or reduced maintenance costs.
Therefore, there will be savings in excess of the figures listed above.

Please note that all DCU’s KW/ hr supply rates are confidential, we have applied an example electricity unit rate of approx Day - €0.15 and Night - €0.09 to all of this report. This is a typical average day/night rate for a similar sized campus in 2009 in Dublin.
Henry Grattan Building

The Henry Grattan building is one of the original university buildings. The 3 storey building is made up of a mix of classrooms, lecture theatres, toilets, offices and computer rooms.

For this project Ciall concentrated on 12 toilets and 20 Classrooms / lecture theatres throughout the building which were about to undergo refurbishment.

The lighting in all of the classrooms was Twin 5’ 58W T8 fittings. The ballasts were extremely old an inefficient. The majority of the fittings were in poor condition and did not emit enough light.

The toilets were lit by low frequency 2d fittings which were on 24hours a day due to a lack of natural light.

Ciall reviewed the various options available and opted to replace the old fittings and install occupancy sensors with lux sensors in each of the classrooms and toilets.

New Fittings

Ciall replaced the ageing Twin 5’ fittings (approx >128Watts each with a poor yellow light) with new modular 600x600 2 x 55Watt PL fittings and lamps. Ciall utilised Galaxy fittings for the installation. Several different fitting types were sampled and tested at the start of the project to get the desired lux level. The result is a much improved light output and aesthetically pleasing light fittings.

Occupancy Sensors

Ciall installed Occupancy and Lux sensors in each classroom and bathroom. Ciall chose occupancy sensor numbers and type to suit
the size and layout of each room, and to avoid ‘blind zones’. Ciall also ensured that in the classrooms the occupancy sensors would still pickup students in a non-moving or seated position.

This resulted in lights only being switched on when A) the room is occupied and B) The natural light levels in the room is too low.

Local override switching had to be installed also to allow lecturers to switch of banks of lights while using digital projectors or OHP’s in the room.
Savings Summary:
The Combination of Occupancy Sensors & New Fittings resulted in a saving of 38274.85kW/hrs per year.

Using our example Electricity Unit rates, this will result in an annual saving of over €5,380 + VAT. NB: The payback period of this project is 4 years due to the clients request for brand new fittings in all classrooms.

![Accumulated Savings Table and Graph]

The Savings above do NOT take into account savings due to extended Lamp Hours or reduced maintenance costs. Therefore there will be savings in excess of the figures listed above.
Conclusion

The combined savings of this project amounts to a total reduction of 375,411kWh of electricity or over 200 tonnes of Co2 per year.

The overall ROI (Return on Investment) was less than 17 months without taking the 60% funding from SEI into account.

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Ciall’s offices are based in Dublin and we carry out works in the Republic of Ireland and Northern Ireland.